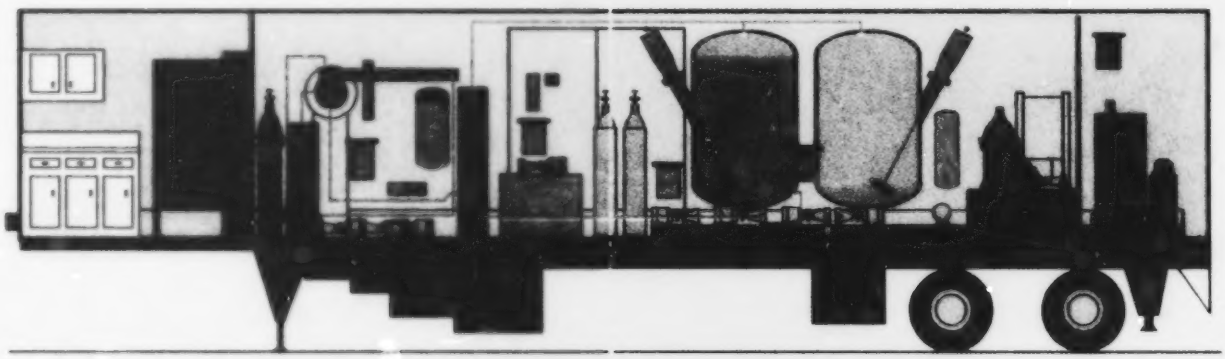
CCME

Canadian Council of Ministers of the Environment

Le Conseil canadien des ministres de l'environnement

Guidelines for Mobile Polychlorinated Biphenyl Treatment Systems

CCME-TS/WM-TRE012E
March 1990



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GUIDELINES FOR MOBILE POLYCHLORINATED BIPHENYL TREATMENT SYSTEMS

Canadian Council of Ministers of the Environment

CCME-TS/WM-TRE012
March 1990

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Ce rapport est aussi disponible en français sous le titre "Lignes directrices applicables aux systèmes mobiles de traitement des biphényles polychlorés (BPC)", à l'adresse ci-dessous.

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ABSTRACT

These guidelines present the Canadian Council of Ministers of the Environment (CCME) recommendations for the assessment, approval, and operation of mobile systems for the treatment of PCB-contaminated mineral oil in Canada. These recommendations are procedures and controls that regulatory agencies and technology proponents should consider for the licensing and operation of mobile treatment technologies for dechlorinating PCBs in contaminated fluids.

The recommendations contained herein are not enforceable by law as federal and provincial regulatory agencies have the legal authority and responsibility to develop regulations in their jurisdictions. However, it is important that there are consistent Canadian requirements. Recommendations in this document, therefore, should serve as a guide in attaining a consistent national policy for PCB disposal.

RÉSUMÉ

Le présent rapport expose les recommandations du Conseil canadien des ministres de l'Environnement concernant l'évaluation, l'approbation et l'exploitation de systèmes mobiles de traitement des huiles minérales contaminées par les BPC au Canada. Ces recommandations portent sur des méthodes et des contrôles dont les organismes de réglementation et les promoteurs des diverses techniques devraient tenir compte pour l'approbation et l'exploitation d'installations mobiles de traitement pour la déchloruration des BPC dans les liquides contaminés.

Les recommandations formulées ci-après ne sont pas exécutoires en droit étant donné que les organismes de réglementation fédéraux et provinciaux ont le pouvoir et la responsabilité d'établir des règlements dans leurs champs de compétence respectifs. Cependant, il importe que des exigences cohérentes s'appliquent dans tout le Canada. Les recommandations contenues dans le présent document devraient donc servir de guide en vue de l'établissement d'une politique nationale cohérente en matière d'élimination des BPC.

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GLOSSARY OF TERMS

Mobile PCB Treatment System	- mobile equipment that is capable of destroying PCBs by chemical means
PCBs (polychlorinated biphenyls)	- chlorobiphenyls (polychlorinated biphenyls) are defined in the federal Chlorobiphenyl Regulation No. 1 as those chlorobiphenyls that have the molecular formula $C_{12}H_{10-n}Cl_n$, where n is greater than 2. (Note: In Ontario, the definition includes all chlorobiphenyls, where n is equal to or greater than 1. All other provinces adhere to the federal definition)
PCB Solid	- any material or substance, such as containers, contaminated soils, shredded capacitors, that contain PCBs at a concentration greater than 50 milligrams per kilogram (50 ppm by weight) of the material or substance
PCB Liquid	- any liquid containing PCBs at a concentration of more than 50 milligrams per kilogram (50 ppm by weight) of the liquid, e.g., PCB fluids, PCB-contaminated mineral oil, aqueous suspensions, and contaminated solvents
PCB Equipment	- any equipment including transformers, capacitors, and other manufactured items that contains PCB liquids
PCB Waste	- PCB equipment, PCB liquid or PCB solid that contains more than 50 milligrams PCB per kilogram of waste (50 ppm by weight) for which the owner has no further use
2,3,7,8-substituted PCDDs	- any polychlorinated dibenzo-p-dioxin with the molecular formula $C_{12}H_{8-n}Cl_nO_2$, where n is from 4 to 8 and the chlorine atoms are located at the 2,3,7,8 positions on the molecule
2,3,7,8-substituted PCDFs	- any polychlorinated dibenzofuran with the molecular formula $C_{12}H_{8-n}Cl_nO$, where n is from 4 to 8 and chlorine atoms are located at the 2,3,7,8 positions on the molecule
2,3,7,8 TCDD Toxic Equivalents	- an abbreviated term for the sum of the 2,3,7,8,-substituted PCDDs and 2,3,7,8-substituted PCDFs after each has been multiplied by the toxicity equivalent factors set out in Appendix V

Demonstration Test	- a test which is undertaken to demonstrate system performance that requires official approval
Local Municipality	- a city, town, village, township or improvement district
Lead Regulatory Agency	- that agency in government which is responsible for promulgating (and ensuring compliance with) emission standards, criteria and/or guidelines; in most instances, excepting federal lands, this is a provincial department of the environment
CCME	- Canadian Council of Ministers of the Environment; previously known as CCREM (Canadian Council of Resource and Environment Ministers)

EXECUTIVE SUMMARY

This report presents the Canadian Council of Ministers of the Environment (CCME) recommendations for the assessment, approval, and operation of mobile systems for the treatment* of PCB-contaminated mineral oil in Canada. These recommendations are procedures and controls that regulatory agencies and technology proponents should consider for the licensing and operation of mobile treatment technologies for dechlorinating PCBs in contaminated fluids.

This report is intended to assist in the development of a uniform system of federal and provincial regulatory programs. Although provinces and municipalities may wish to adopt additional or more stringent requirements, these recommendations provide an adequate level of regulatory control for the well-managed treatment of PCB fluids in mobile chemical dechlorination systems.

An overview of the recommended regulatory approvals process for such PCB treatment systems is presented in Figure 1. The recommended safeguards and procedures are straightforward relative to the recommended controls for PCB incineration systems, and this is appropriate in view of significant differences between the two types of technology. Polychlorinated biphenyl chemical dechlorination is a proven technology which has been successfully utilized in numerous commercial applications since 1981.

The recommended approvals process shown in Figure 1 initially requires a systematic evaluation and verification of the ability of a technology to effectively decontaminate PCB-contaminated fluids. As chemical dechlorination systems do not generate significant air emissions, the major focus of the recommended approval procedures is directed toward requirements for PCB waste handling and solid/liquid process waste disposal. Pertinent criteria to be considered for siting requirements also are suggested. Proponents of commercially established systems will generally be able to meet all recommended requirements on the basis of data from tests and operation in other jurisdictions.

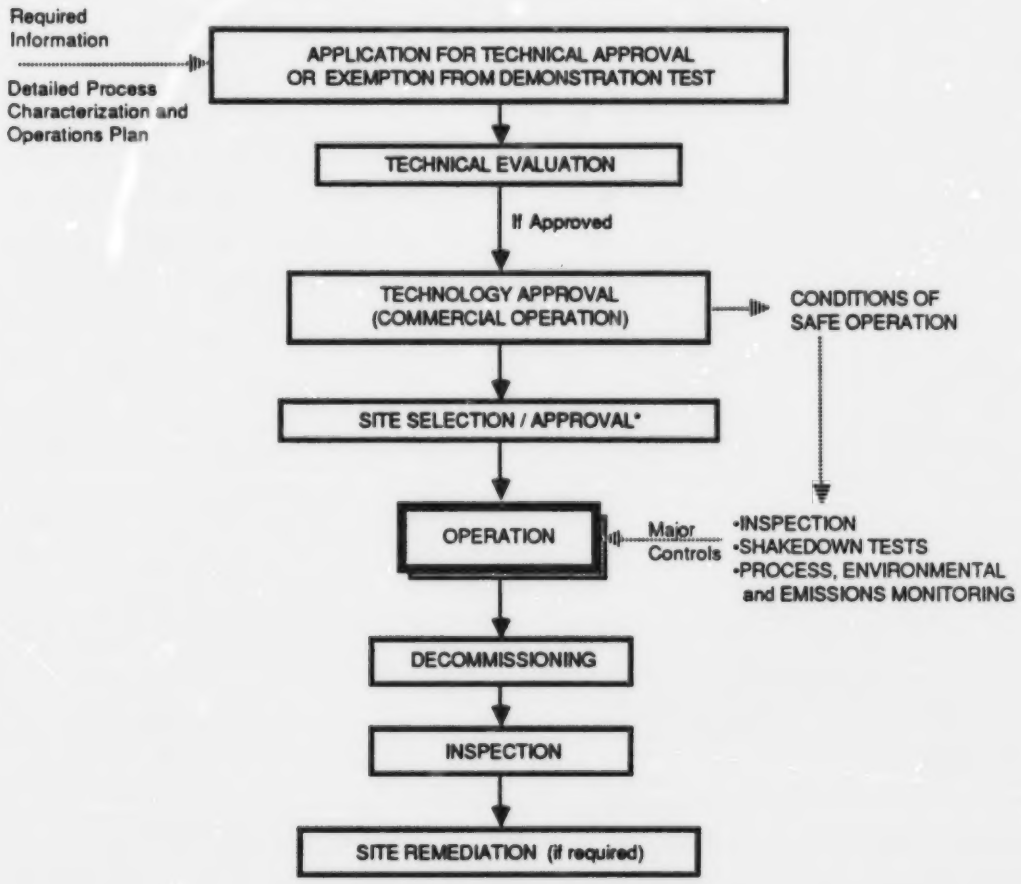
The recommended regulatory approvals process requires the proponent to submit detailed information to the permitting regulatory agency **prior to undertaking any tests or operations with PCB wastes.** This submission should include:

---

* "mobile PCB treatment system" means mobile equipment that is capable of destroying PCBs by chemical means.

- a test plan which addresses all aspects of routine and emergency response activities;
- a description of all monitoring, analytical, and assessment procedures to be used during operations;
- a plan for controlled disposal of all process residues; and
- a plan for monitoring process operation throughout testing (if applicable) and during routine operations.

The procedures and controls recommended in this manual are considered to be appropriate in providing the technical assurances that mobile PCB treatment processes will operate with minimum risk of environmental impact.



*Siting approvals will generally be included with technology approvals for in-situ equipment decontamination.

FIGURE 1 OVERVIEW OF THE RECOMMENDED APPROVALS PROCESS FOR MOBILE PCB TREATMENT SYSTEMS

1 INTRODUCTION

1.1 Purpose

The purpose of this report is to recommend appropriate procedures with respect to the application, siting, and operational requirements for mobile polychlorinated biphenyl (PCB) treatment systems in Canada. The technologies addressed are:

a). chemical dechlorination processes for bulk-oil PCB decontamination; and

b). in-situ treatment systems.

The recommendations contained herein are not enforceable by law as federal and provincial regulatory agencies have the legal authority and responsibility to develop regulations for their own jurisdictions. However, it is important that there are consistent Canadian requirements. Recommendations in this document, therefore, should serve as a guide in attaining a consistent national policy for PCB disposal. These recommendations should be useful to:

- **proponents** seeking federal and provincial government approval to operate PCB treatment facilities by recommending the essential criteria that should be met in order to operate on a commercial basis;
- **regulators** of waste management practices, by:

  a). outlining recommended procedures and criteria that can be used to evaluate data provided in proponent applications for approval,

  b). identifying criteria for monitoring the performance of operating facilities, and

  c). providing a reference framework which may be used in the drafting of provincial regulations;

- **other interested parties and public**, by identifying procedures to assure that a consistent policy will be applied in the approvals process and PCB destruction programs.

The primary focus of this report is to describe or recommend protocols for each step of the PCB waste management process for mobile treatment systems for decontaminating PCB-containing oils. Specific technologies are discussed in an Environment Canada report(1), and a summary of available technologies and their current operating status is provided in Appendix 1.

Information from various reports and documents has been consolidated in the preparation of these guidelines; however, to maintain consistency, information was mainly

derived from reports or publications by Environment Canada[1,2]; the Canadian Council of Ministers of the Environment [3]; the Ontario Ministry of the Environment[4 to 7], and the United States Environmental Protection Agency[8,9]. A report of similar scope has been prepared for thermal destruction technologies, such as liquid injection and rotary kiln incinerators for the destruction of PCB wastes[10].

1.2 Appropriate Controls for Mobile Treatment Systems

A summary of operating characteristics and PCB management concerns for the application of mobile chemical dechlorination technologies of PCB wastes is presented in Table 1. These characteristics are typical of most chemical treatment technologies and affect the scope of regulatory controls for environmental protection.

As shown in Table 1, chemical dechlorination processes are applied in at least two very different situations:

- to in-situ treatment of PCB-contaminated oils in electrical equipment that may be energized or out-of-service; and
- to the treatment of bulk contaminated oils at a centralized location.

In-situ treatment must, of necessity, be undertaken at the location of the equipment, and the duration of treatment may be limited to a few days. In contrast, the treatment of bulk oils may involve the decontamination of large volumes of PCB wastes or the establishment of a semi-permanent facility, and site selection gives more flexibility. These considerations must be taken into account in determining the scope and specific nature of regulatory controls which are appropriate for a particular situation.

Since chemical PCB dechlorination systems do not generally present concerns about contaminant dispersal in air emissions, controls for activities involving the chemical dechlorination of PCBs are principally directed at materials handling activities. Handling of PCBs can be suitably controlled with planning, procedures, and equipment which are relatively straightforward and commonly used in dealing with any toxic chemicals. Examples of such controls include:

- providing proper education and training for all personnel who work with or near PCBs;
- providing safe physical packaging and containment of PCBs during all activities peripheral to the treatment process (handling, transportation, and storage); and
- ensuring safe working practices and measures for protecting personnel who work with or near PCBs.

TABLE 1 OPERATIONAL CHARACTERISTICS AND REGULATORY REQUIREMENTS FOR TYPICAL PCB CHEMICAL DECHLORINATION SYSTEMS

	Full-scale, Commercial Systems	
Consideration	Bulk Oil Decontamination	In-situ Decontamination
Principal Application	- decontamination of bulked PCB-containing oils (subsequent oil recovery or disposal as non-PCB waste)	- in-situ decontamination of PCB fluids in operational electrical equipment
Treatable Waste Types	- liquids only to 10 000 ppm PCB	- liquids only to 10 000 ppm PCB
Duration of Operations at Each Site	- days to weeks depending on volumes	- days, depending on the quantity of equipment to be treated
Siting Flexibility	- generally flexible; - constrained by requirements to transport bulked oils	- in-situ treatment requires operation at the site of the installed equipment
Waste Volume Treatable per Site	- 1000's L/day	- 100's to 1000's of litres per unit of equipment
Principal Process Emissions	- solid and liquid treatment residues	- solid and liquid treatment residues
PCB Regulatory Requirements	- to ensure proper transport and storage of wastes moved to the treatment site - to ensure consistent application of good general operational practices at the site throughout the term of operation - to control off-site disposal of residues	- to ensure application of good operational practices at the site during setup, short-term operation and departure - to control off-site disposal of residues

In addition to the types of PCB handling controls previously mentioned, processes should undergo technical scrutiny by regulatory agencies to confirm that specific operating characteristics do not pose a risk of PCB dispersal through routine or abnormal releases (e.g., by catastrophic failure of the process including fire and/or explosion). It is also appropriate to impose careful monitoring and compliance controls on contaminants in treatment residues.

The requirements recommended in this report apply to the procedures and controls that regulatory agencies and proponents should consider in regulating PCB treatment systems. Information is given on the current status of PCB regulations and national emission criteria which are adequate environmental performance requirements that PCB treatment facilities should achieve. Recommendations are directed toward all major aspects of PCB treatment from technology and site application considerations, through operational, monitoring and other activities, to facility decommissioning. Overall, the approval process suggested in this manual is intended to assure that controls are implemented in a thorough and systematic fashion.

2 SYNOPSIS OF PERTINENT PCB REGULATIONS IN CANADA

2.1 Status of Regulations

Proponents or customers of PCB destruction facilities should be aware of the many acts and regulations which govern not only PCB destruction but also the handling, storage, transportation, cleanup and reporting aspects of PCB waste management. Polychlorinated biphenyls are environmental contaminants and, as such, their regulation and control is considerably more detailed and demanding than most other pollutants.

Federal regulations under the *Canadian Environmental Protection Act* address limitations with respect to: PCB use[11]; import or sale of PCB equipment[12]; and release of PCBs to the environment during commercial, manufacturing, or processing activities[13]. The "Interim Order on the Storage or PCB Wastes" was issued in 1988 and should be followed by a regulation in 1990[14]. This Order stipulates controls on the proper storage of these wastes. In January 1990, the Federal Mobile PCB Treatment and Destruction Regulations[15] were issued which limit gaseous, liquid, and solid emissions from these facilities operating at federal facilities. A summary of these regulations along with provincial regulatory status is included in an Environment Canada report[2] which presents recommended practices for the management of PCB wastes. Similarly, provincial PCB regulations that are in place or being developed, and those of other countries, are summarized in a report prepared for CCREM[3].

Specific PCB regulations applicable to mobile facilities have been prepared in Ontario[4 to 7] which specify requirements for that jurisdiction. A summarized flow diagram of the essential features of the Ontario approvals process is provided in Appendix II. Nevertheless, applicable federal, provincial, and municipal regulations must be adhered to, and the appropriate enforcement agencies must be contacted for complete information regarding requirements which may affect the siting and operation of mobile PCB facilities.

2.2 Discharge Criteria

The principal regulatory controls for chemical dechlorination processes are emission criteria which regulate the discharge and disposal of solid, liquid, and gaseous emissions from the process. Because the majority of the PCB treatment systems operate at ambient or somewhat higher temperatures and because they are partially or entirely closed, only minor (or no) direct discharges to air are expected from vents or other process components. The most important regulatory controls for chemical treatment

processes, therefore, apply to solid/liquid discharges. Quench waters or process condensate must be further treated if they contain unacceptable contaminant levels. Solid wastes, comprised largely of reaction by-product sludges, fullers earth* and other residues, must not contain more than 0.50 mg/kg PCBs if they are to be declassified as PCB wastes. The handling and storage of PCB wastes prior to destruction is also regulated to eliminate environmental contamination from spills and leakage.

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* fullers earth - an earthy substance mainly consisting of clay mineral used as an adsorbent, filter medium, or a carrier for catalysts

3 TECHNICAL REQUIREMENTS FOR MOBILE LOW-LEVEL PCB TREATMENT

Releases of PCBs and other toxic reaction by-products to the environment during chemical PCB dechlorination processes are regulated by restricting the allowable level of these compounds in solid and liquid treatment residues from the process. In contrast to thermal destruction processes, air emissions are a minor concern and regulatory process performance standards (such as those used for air emissions from thermal destruction processes) are unnecessary.

The regulatory requirements for mobile PCB treatment systems and/or limitations on pollutant emissions will be determined by the lead regulatory agency. Figure 2 indicates federal emission criteria for mobile PCB treatment systems; these include:

- **Concentration limitations for PCB in wastewaters (5 µg/L) and solid residues (0.50 mg/kg) from the treatment process.** Residues with PCB concentrations exceeding these limits should not be discharged from the site. Additional treatment or handling as a special or hazardous waste would be required.
- **Control of all process vents and points of process releases to air** with activated carbon filters designed and demonstrated to be effective for PCB removal. Any air emissions occurring from process vents should be limited to a PCB content $\leq 1 \mu g/Nm^3$.

It is therefore recommended that concentrations of PCBs in process emissions or discharges should not exceed these requirements or other specific provincial limits (whichever is more stringent).

In addition to these controls, it is recommended that chemical dechlorination systems incorporate automatic process controls which would interrupt the waste feed or shut down the process in the event of any condition which could cause a fire, explosion, or other catastrophic failure.

The concentration limitations on PCBs in the solid and liquid process residues assure control of releases of these compounds to the environment. Monitoring of process emissions is a recommended requirement to verify that emissions are in compliance with these limitations.

Additional recommended technical requirements for site activities are primarily directed at ensuring the responsible management of PCB wastes in the various handling and storage activities which support the operation of the treatment facility. These requirements include recommended procedures for the design and operation of the

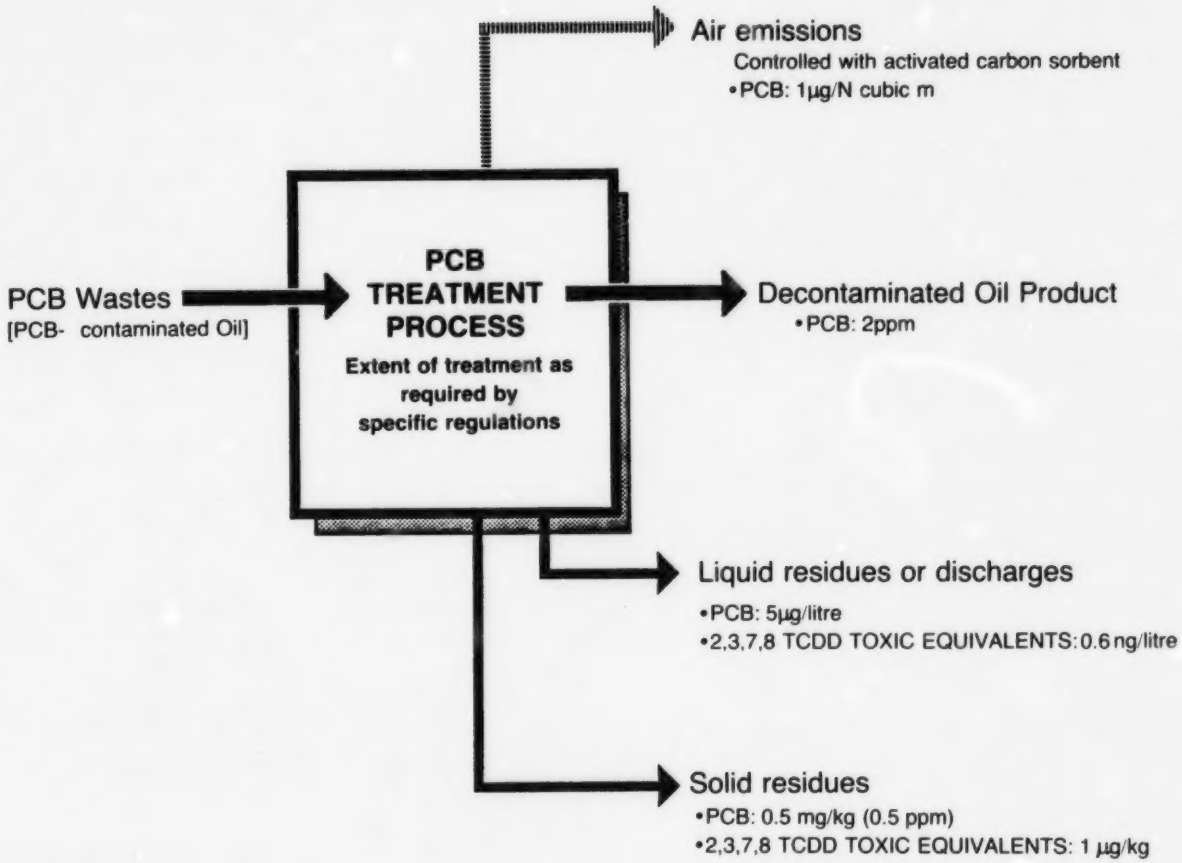

FIGURE 2 FEDERAL PERFORMANCE/DISCHARGE CRITERIA FOR MOBILE PCB TREATMENT SYSTEMS

facility to provide effective overall control of PCB materials and to minimize exposure to operators, to prevent spills or releases to the environment, to contain and effectively recover any accidental releases, and to prevent fire or explosive release of PCBs. It is recommended that approval for the operation of the facility be contingent on verification that the proponent will comply with these requirements.

4 RECOMMENDED PERMITTING PROCEDURES AND REQUIREMENTS

Except for federal facilities, authorization to operate a PCB treatment facility in Canada is a provincial responsibility and the regulatory framework to authorize operations is usually province-specific. Information on specific jurisdictional requirements or the submission of applications to initiate the approval process should be directed to the appropriate provincial regulatory agency (Table 2).

The types of activities that typically require permits are full-scale operations, demonstration tests, and research tests (Appendix III). In accordance with existing provincial regulations, it is recommended that technology permits be separate from facility siting permits.

4.1 Permit Applications

4.1.1 Information Required. The basic information required in permit applications may vary among jurisdictions and will depend, in part, on the type of technology and the extent of operating experience. An example of a recommended permit application format and content for technology approval for a PCB treatment facility is provided in Appendix III. A summary of these recommended requirements is shown in Table 3.

4.1.2 Data Quality Assurance Plan. It is recommended that a formal data quality assurance plan be required and submitted with the application. This plan is the mechanism by which the proponent should designate the specific procedures which will ensure that the precision, accuracy, completeness, and representativeness of the data collected during operation and/or any testing are of sufficient quality to meet the requirements of the approval agency(ies). The plan should address items such as: process safety aspects, process operating measurements, feed and discharge analysis, inspection schedules, and report and record-keeping activities. Approval of the plan would be a prerequisite for undertaking tests or routine operation of a mobile PCB treatment system.

4.2 Facility Siting and Scheduling

It is recommended that a definite operating period at a given site be specified as a condition for approval. This period should be determined by any jurisdictional stipulations and other factors. The objective of this time constraint is to ensure that mobile facilities do not establish permanently in any one municipality, thereby minimizing the risks associated with the transportation of contaminated oils to the site. As discussed in Section 5, this is not applicable to in-situ treatment of contaminated oil in fixed electrical equipment.

TABLE 2 REGULATORY AGENCIES

Province	Authorizing Agency	Authorizing Branch	Address	Telephone
Northwest Territories	Government of the Northwest Territories, Dept. of Renewable Resources	Pollution Control Division	P.O. Box 1320 Yellowknife, NWT X1A 2L9	(403) 873-7654
Yukon Territory	Dept. of Community and Transportation Services	Community Services	P.O. Box 2703 Whitehorse, Yukon Y1A 2C6	(403) 667-3032
British Columbia	Ministry of the Environment	Waste Management Branch	810 Blanshard St. Victoria, B.C. V8V 1X5	(604) 387-1161
Alberta	Alberta Environment	Environmental Protection Service Standards and Approvals Division Industrial Waste Branch	9820-106 Street Edmonton, Alta. T5K 2J6	(403) 427-5838
Saskatchewan	Saskatchewan Environment and Public Safety	Air and Land Protection Branch, Waste Management Services	Walter Scott Bldg. 3085 Albert St. Regina, Sask. S4S 0B1	(306) 787-6191
Manitoba	Manitoba Environment and Workplace Safety and Health	Environmental Management Services	Building 2 139 Tuxedo Ave. Winnipeg, Man. R3N 0H6	(204) 945-7094
Ontario	Ministry of the Environment	Waste Management Branch	40 St. Clair Ave. W. Toronto, Ontario M4V 1P5	(416) 323-5151
Quebec	Ministère de l'Environnement	Direction des substances dangereuses	3900 rue Marly Ste-Foy, P.Q. G1X 4E4	(418) 643-3794
New Brunswick	Municipal Affairs and Environment	Environmental Protection Branch, Toxic Substances Section	364 Argyle Place P.O. Box 6000 Fredericton, N.B. E3B 5H1	(506) 453-2861
Nova Scotia	Nova Scotia Dept. of the Environment	Field Services	5151 Terminal Rd. Centennial Bldg. P.O. Box 2107 Halifax, N.S. B3J 3B7	(902) 424-5300
Prince Edward Island	Dept. of the Environment	Environmental Management Division	Jones Bldg. 11 Kent St. P.O. Box 2000 Charlottetown, PEI C1A 7N8	(902) 368-5320
Newfoundland	Dept. of Environment and Lands	Environmental Investigations Branch	Confederation Bldg. West Block, 4th Floor P.O. Box 8700 St. John's, Nfld. A1B 4J6	(709) 576-2559
Federal Facilities	Federal Dept. of Environment	Industrial Programs Branch	Place Vincent Massey 351 St. Joseph Blvd. Hull, Quebec K1A 0H3	(819) 953-1119

TABLE 3 RECOMMENDED CONTENT FOR A TECHNOLOGY PERMIT APPLICATION

To Address	Specific Information
Technology Description	- including process design and emission controls
PCB Feed	- nature and quantity of PCB contaminated oils to be treated with description of pre-treatment requirements, feed handling procedures (feed storage if applicable), and automated shutdown systems
Reagents	- nature and quantity of process chemicals or reagents to be used
Process Controls	- control features and performance monitoring procedures
Product Disposal	- procedures to clarify or upgrade the decontaminated mineral oil and product handling or disposal methods (where applicable)
Expected Discharges	- identify expected process discharges and air emissions (if applicable) with monitoring procedures
Quality Assurance Plan	- procedures to validate data
Inspection	- procedures for inspection and record keeping
Emergency Plan	- spill prevention and safety measures with emergency contingency plans
Operational Plan	- including startup, shutdown, and site closures
Waste Disposal	- identify solid/liquid waste and decontamination product disposal procedures
Performance Data	- data to verify successful PCB treatment and adherence to existing regulations including solid/liquid waste concentrations
Organization	- delineate staff functions, responsibilities, and training

Proponent applications for siting bulk oil decontamination facilities should include the following types of information:

- other certificates of approval (e.g., technology and/or other site operations);
- the location and characteristics of the proposed site and information to indicate how it satisfies available jurisdictional site selection criteria; and
- a proposed operating schedule which specifies activities from initial site preparation to final closure of the facility including the proposed frequency of operations at any site within the same municipality.

Proponent applications for locating in-situ treatment processes should provide information on the locations and characteristics of all sites for the proposed treatment within the jurisdiction (i.e., separate site approval may/may not be required) and a proposed operating schedule.

4.3 Liability Coverage

A large liability could be incurred from such mishaps as: an accidental discharge, spill, or fire, that would require cleanup. The proponent's application for approvals should describe the type and amount of insurance coverage or other compensatory means for such accidents.

In addition, prior to testing or operating each treatment facility within a jurisdiction, it is recommended that a proponent be required to provide a monetary assurance to the regulatory agency (e.g., posting of bond or other asset in an amount determined by the regulator) to ensure that adequate funds are available for site restoration. This is regarded as a requirement in addition to insurance needs. Claims on this monetary assurance would be relinquished after it has been determined by the regulator that no site restoration is required.

4.4 Permit Evaluation and Approval

Evaluation. It can be expected that permit applications for operating PCB treatment facilities will be closely scrutinized and reviewed. It is the regulator's responsibility to develop criteria for evaluating the completeness and quality of the proponent's application. Using these criteria, the regulator may:

- approve or refuse approval of the facility to operate without further testing;
- require submission of additional information; or
- require demonstration tests to be performed according to the regulator's stipulations.

Approval. Treatment facilities that meet specified regulations and criteria should then receive technology approval which permits the facility to operate at any location within the jurisdiction after site approval has been granted. In determining site approval, the regulator may solicit public comment which will need to be addressed in considering the application. Upon satisfying siting requirements that are appropriate to the type of technology, operations should be permitted to commence in accordance with specified conditions and procedures and/or stipulated by provincial regulatory agencies. If a demonstration test is required, suggested procedures are found in Appendix IV.

5 SITE SELECTION

This section outlines criteria that should be considered in evaluating and selecting sites for commercial operation of mobile low-level PCB treatment facilities, or for conducting process demonstration tests and/or research and development tests.

As noted previously, chemical dechlorination processes may be applied in situations ranging from:

- in-situ treatment of PCB-contaminated oils in electrical equipment; to
- the treatment of bulk contaminated oils at a centralized location.

The in-situ treatment of electrical equipment must, of necessity, be undertaken at the location of the equipment, and the duration of treatment may be limited to a few days. In contrast, the decontamination of bulk oils may involve the establishment of either a temporary or even semi-permanent facility, and site selection involves more flexibility (see Table 1). These considerations must be taken into account in determining the scope and specific nature of controls on site selection which are appropriate to the particular situation.

Although all applicable criteria should be considered in siting bulk oil decontamination facilities, it is impractical to attempt to select a site which meets all of the criteria. Site selection, therefore, must be regarded as a trade-off between attempting to meet ideal site criteria and providing mitigative measures to compensate for those siting criteria which are not fully met. Specific approaches and criteria for selecting and approving sites should be stipulated by the lead regulatory agency in consultation with affected municipalities.

5.1 Siting Criteria

5.1.1 Separation from Receptors. The purpose of providing a separation distance or buffer zone between treatment facilities and sensitive receptors (e.g., occupied buildings and other establishments) is to provide an added level of protection in case of accidents. Various jurisdictions have specified minimum separation distances and the lead regulatory agency should be contacted regarding the actual distance to be considered in siting. For example, in Ontario[6] no separation distance is stipulated for in-situ treatment processes and a 20 m separation distance between bulk oil treatment facilities and sensitive receptors has been regulated.

The location of the mobile facility site for treating bulk oils should be compatible with surrounding land uses (e.g., zoned industrial land).

5.1.2 Separation from Surface Waters. To provide a second level of control for spill prevention and containment measures, minimum separation distances from surface waters or drainage areas should be maintained. For systems treating significant volumes of bulk PCB-contaminated oil, every effort should be made to meet this criterion. Specific separation requirements should be ascertained from local regulatory officials. A 100-m separation of facilities and associated waste storage areas from drainage systems or watercourses is regulated in Ontario[6]. In cases where electrical equipment, requiring in-situ treatment, is located close to surface waters or drainage areas, particular attention should be directed toward the use of impermeable impoundments or barriers to isolate facilities from drainage areas.

5.1.3 Surface Geology and Groundwater. The surficial geology of the site should be such that groundwater migration of spills or leaks will not occur. This criterion for relatively impermeable surface geology is to provide a level of protection additional to normal spill containment and prevention measures. This criterion applies mainly to systems providing bulk oil treatment.

5.1.4 Topography and Size. When applicable, the site should be level, with suitable foundation and surface area for the destruction units, support equipment and waste storage area. It should provide access for proper implementation of spill cleanup procedures if required.

5.1.5 Proximity to Wastes. Mobile PCB treatment units should be located within reasonable access to the wastes to be destroyed. This is an important criterion in siting mobile units to be used for treating bulk contaminated oils at a centralized location. As the site becomes further removed from the source of wastes, the risks, costs, and logistics of waste transportation may increase to the point that advantages of adopting mobile technologies are defeated. Moreover, in-situ treatment of oil in electrical equipment requires the mobile unit to go to the existing location of the equipment.

5.1.6 Site Services and Access. The site should have suitable provisions for services such as power, water, space for the units, waste storage (where applicable) and treated liquid effluent containment or discharge. Adequate road access for the mobile treatment unit is a requirement. For example, some components of mobile units are transported on trailers which require minimum clearances for units. Sufficient load-bearing capacities on roads also should be available.

5.2 Operator and Regulatory Agency Responsibilities

The selection of the site should be the responsibility of the proponent or operator of the PCB treatment system. In site applications, the operator should address the previously mentioned criteria in the site evaluation and selection process. It is the responsibility of the operator and the lead regulatory agency to decide on the specifics of siting requirements, such as separation distances.

One agency in each jurisdiction should act as the lead agency for all government requirements and permitting (see Table 2). A list of all agencies imposing requirements should be available with contact names and addresses from the lead agency. On the other hand, actual site authorization can be expected to be granted, where appropriate, by provincial regional officers in co-operation with local municipal officials (e.g., municipal clerk, medical officer, fire official).

Public notification of preferred sites should be required by the lead agency when extensive treatment operations are to occur at the site (e.g., treatment of large oil volumes over an extended period of time). It is recommended that solicitation of public comment should be the responsibility of the lead regulatory agency or designee. This may be in the form of public notices and/or meetings within each affected municipality. The mechanisms should be stipulated by the lead agency. Both the proponent and regulator should be prepared to address public concerns with respect to the site selection and/or the application of the technology and to ensure that the public is accurately informed of the reasons for selection of the site.

6 OPERATING REQUIREMENTS AND PROCEDURES

The objective of the following requirements is to ensure that all operational activities at the mobile facility site are planned and undertaken in a manner to prevent releases of PCBs and associated contaminants to the site of the treatment process and surrounding environment. Some of these requirements apply only to facilities treating on-site bulk PCB liquid wastes as opposed to in-situ treatment of transformer fluids, and these have been noted accordingly. Otherwise, these recommendations apply to both types of operations.

6.1 Facility Start-up

6.1.1 Approvals. The start-up of any PCB destruction facility should require prior, formal approval from the lead regulatory agency. It is recommended that the procedures and controls for the operation of such facilities as outlined in this document be adopted as minimum requirements. These minimum requirements include the prior approval of all plans submitted in technology and site applications.

6.1.2 Start-up Procedures. Prior to initial start-up (i.e., when first operated within a given jurisdiction), the lead regulatory agency should inspect the facility to verify its ability to operate in compliance with all regulatory requirements. The proponent should be required to follow a written start-up procedure which has been reviewed and approved by the lead regulatory agency.

6.1.3 Monitoring System Check. Prior to start-up and/or the introduction of waste feed to the process, the proponent should demonstrate the proper functioning and calibration of all monitoring instruments. This should be carried out in accordance with the Data Quality Assurance (DQA) Plan.

The proper function of automatic shutdown systems should be demonstrated during other system checks.

6.1.4 Waste Transport. For bulk processing at a semi-permanent location, it is recommended that approval to transport PCB-contaminated liquids to the site, where applicable, be contingent upon demonstration that the PCB destruction system can comply with the conditions described in this section. Any transport of PCB wastes to a site must comply with federal and provincial requirements.

6.2 Nature and Quantity of Waste to be Treated

6.2.1 Documentation. The specific source, identity, and nature of all PCB-contaminated mineral oils intended for bulk or in-situ treatment at the site should be clearly documented in accordance with procedures defined in the proponent's submission for approvals. This documentation must be consistent with applicable federal and provincial marking and transportation requirements.

Documentation should also verify compliance with any constraints on the quantity, type, and concentration of PCB waste brought to, stored, or treated at the site. Such constraints should be specified in advance by federal and provincial regulatory agencies in consultation with local municipalities.

6.2.2 Waste Type. Any PCB-contaminated liquids transported to the site for bulk processing (e.g., contaminated mineral oil in containers) should be compatible with the type and concentration of wastes within the storage, handling, and treatment capabilities of the facility.

The amount of extraneous materials associated with the PCB liquid waste to be treated (e.g., excess water, or other impurities) should be known prior to waste transport (where applicable) since these materials will normally require removal before processing and subsequent disposal. In cases where PCB wastes contain substantial volumes of water, for example, disposal requirements of this as well as other process wastes should be determined and stipulated as a condition of approval.

The maximum PCB concentration in liquids that can be treated by bulk and in-situ processes depends to a large extent on process economics (i.e., the feasibility of recycling until the desired level of PCB destruction is achieved). A maximum concentration that can effectively be treated, therefore, should be defined in proponent applications, with supporting documentation of demonstrated capabilities, and then stipulated as a condition of approval to operate at or below the maximum concentration.

6.2.3 Waste Quantity. In the case of a demonstration test, the total quantity of contaminated oil brought to the site of the mobile facility (if applicable) should not exceed the quantity required for the demonstration. In the case of approved commercial operation of bulk treatment systems at a site, the total quantity of PCB liquid transported to and treated at the site (if applicable) should be stipulated as a condition of approval. The total quantity of PCB waste brought to and/or stored at the site should be consistent

with the capability of storage facilities at the site. Storage capabilities at the site should be such as to minimize transport of waste to the site.

6.3 Chemical Reagents

The chemical composition of all reagents used in the process should be supplied to the lead regulatory agency at the time of application in order to identify specific contaminants which could potentially occur in process discharges (e.g., trace metals). Any contaminants of concern should be subsequently measured in process discharge while either conducting a demonstration test (if required) or on specified occasions during commercial operation. Provisions should be made by the lead regulatory agency for keeping proprietary reagent information confidential.

6.4 On-site PCB Waste Storage

This section applies only to new temporary PCB waste storage facilities which are established for bulk liquid PCB waste treatment by mobile chemical treatment facilities. It does not apply to the use of mobile facilities at an existing PCB waste disposal site or industrial property where PCB liquids are in approved use or storage and are awaiting treatment.

6.4.1 Objective. For those facilities designed to treat liquid PCBs in bulk storage, any temporary on-site PCB waste storage area should be confined to a designated and clearly defined area as recommended by Environment Canada[2] and/or stipulated within each jurisdiction. The designated area should be used exclusively for waste PCB storage and should be designed and operated to minimize all PCB releases to air, ground, and water including releases resulting from floods, storms, or fire-fighting activities. The operator must provide secure, controlled storage which prevents direct human contact with wastes. The storage area should be designed to prevent spills or releases of PCB to the surroundings, including direct or indirect releases to a watercourse or groundwater. Effective provision must be made for containment and cleanup of any PCB releases which may occur accidentally.

6.4.2 Site-specific Requirements. The term of operation, stored waste quantity, and local conditions will influence the specific design of on-site PCB waste storage facilities. In addition to the following recommended requirements, PCB waste storage facilities must comply with all applicable federal, provincial, and local regulations, requirements, and guidelines.

6.4.3 On-site Location. The primary on-site waste storage facility should have safe and controlled access to the treatment system, separation from combustible and/or explosive materials (e.g., solvents), and separation from any other activities which may endanger safe storage.

Liquid bulk storage facilities should be located at least 100 m from the nearest watercourse and site features should generally comply with the siting requirements specified by the lead regulatory agency.

6.4.4 Containment. It is recommended that a leakproof containment system be provided for liquid PCB storage areas. Liquid PCB wastes must be stored in sealed containers or tanks within the containment area. The storage area should provide effective containment for the "worst-case" spill event. Provisions should be made for effectively removing spilled liquids from the containment area.

Measures should be provided to prevent the infiltration of precipitation to all storage areas. Precipitation which contacts waste containers and/or enters the waste storage area should be retained and, if necessary, disposed of as contaminated wastewater.

Where applicable, appropriate precautions should be taken to prevent PCB releases resulting from container or equipment rupture due to mechanical shock or exposure to extreme ambient temperatures.

6.4.5 Ventilation. Good ventilation should be provided for enclosed areas where PCB liquids are stored, especially where temperatures may exceed 25°C. Vapours from bulk liquid PCB tanks should be vented to the atmosphere through activated carbon filters.

6.4.6 Security. The storage area should be fenced or enclosed with controlled access through lockable gates or doors. Access to the area should be limited to authorized personnel. Effective protection should be provided to prevent entry by vandals or unauthorized personnel.

6.4.7 Signing and Container Marking. The storage area should be clearly identified as a PCB liquid waste storage area. Waste containers should be identified in accordance with Environment Canada labelling requirements and any other provincial, federal, or user-equivalent marking requirements.

6.4.8 Housekeeping. The storage area should be kept clean and orderly. Waste containers should be placed in an orderly and systematic arrangement with attention given

to conventional rules of safety concerning impact protection of containers where vehicular access to the area is allowed.

6.5 Controlling and Monitoring Operations

6.5.1 Selecting Process Conditions. The proponents applications for approvals should describe specific controls which will ensure safe operation of the process. For example, if gases are generated, the need for vapour head-space in the reactor should be considered in the approvals submission (e.g., 20% of the total reactor volume capacity is regulated for one process in Quebec). If heat is generated, a maximum temperature during operation should be stipulated. Some processes require a nitrogen purge within the reaction vessel to avoid operational upset or risk of explosion.

6.5.2 Allowable Ranges of Process Conditions. Safe operating conditions should be maintained during all operations of the PCB treatment system. Allowable ranges of operating parameters should be predetermined and stipulated as a condition of the approval to operate.

6.5.3 Monitoring Process Conditions. Process conditions should be monitored continuously during all operations. The monitoring equipment, procedures, and record keeping should be in accordance with the detailed Data Quality Assurance Plan.

For facilities approved to treat mineral oil in energized transformers, feed concentrations and flows should be closely monitored and controlled to ensure safe operation of the electrical equipment under treatment (e.g., voltage limitations should be stipulated).

6.5.4 Automatic Shutdown. It is recommended that an automatic shutdown system be used to interrupt the PCB waste feed to the system if process conditions fall outside of stipulated safe operating ranges. The system should also automatically initiate any other appropriate shutdown actions.

6.6 General Operational Controls

The operators of mobile PCB treatment facilities should comply with the minimum requirements for PCB waste storage, handling, transportation, occupational health and safety, and contingency planning as presented in this report. Equipment and practices must also comply with provincial and local regulatory requirements or codes and should comply with applicable Environment Canada recommendations as set out in the "Handbook on PCBs in Electrical Equipment"(16).

6.6.1 Prevention of PCB Releases. The facility should be designed and operated to minimize fugitive emissions and spills of PCB materials and the equipment should incorporate PCB-compatible materials. The number of connections used in piping for transferring PCB liquids should be minimized. There should also be confirmation that the PCB content of the decontaminated transformer oil has been reduced to an acceptable level. For some processes, confirmation should be done before upgrading for oil reuse is initiated. In continuous processes, the final PCB content of decontaminated transformer oil should be determined.

6.6.2 Containment. Effective containment should be provided at all potential points of PCB leakage or spillage. For example, drip pans should be placed under all transfer line connections and all surface drains in the vicinity of the work area should be eliminated or tightly blocked. The mobile facility should incorporate a spill pan to contain any leakage from lines, vessels, or other equipment. The containment pan volume or the capacity of other containment devices should be greater than the combined capacity of all processing equipment of the unit. Empty backup vessels with pumping devices should be available to drain process vessels and/or store other materials. Where applicable, processing facilities and/or waste storage areas should be isolated from surface waters or drainage systems with the use of impermeable impoundments or barriers. Precautions should also be taken to prevent the infiltration of precipitation to impoundments, spill trays or containment systems. Where such infiltration occurs, the liquid should be retained and treated as an aqueous waste.

6.7 Emission and Compliance Monitoring

6.7.1 Demonstration Tests. Should demonstration tests be necessary, detailed process and emissions monitoring will be required during testing. The object of this monitoring is to determine safe operating ranges of process conditions.

Polychlorinated biphenyl waste treatment during demonstration tests should be immediately terminated if process conditions undergo excursions from safe operating ranges that have been designated in the proponent's demonstration test plan (automatic shutdown should be initiated); if air pollution guidelines or standards are found to be exceeded; or any other unsafe conditions are identified.

6.7.2 Approved Operation. After operational approvals have been granted, decontamination of PCB wastes should be controlled by continuous monitoring of process conditions, with automatic shutdown if excursions occur outside safe ranges of

parameters. Operators of dechlorination processes should also be required to determine the PCB content of both waste-feed and product streams by routine monitoring in order to document the extent of treatment and verify that PCBs in the product have been reduced to acceptable levels. Treated mineral oil returned for use in transformers should be analyzed for PCB content after an elapsed period defined by the regulator (e.g., 90 days has been recommended in Ontario). This is to account for the possible re-absorption of PCBs from transformer components into the treated oil and to ensure that the transformer is properly declassified. In addition, confirmatory environmental monitoring may be required by provincial regulations to confirm that soil contamination, for example, has not occurred.

The requirements recommended here are to continuously monitor process conditions and to monitor PCBs in the feed and product by approved methods during operation at all sites.

All monitoring and data reduction and assessment during approved operation should be in accordance with the Data Quality Assurance Plan.

6.8 Material Discharges

6.8.1 Wastes and Residues. All process liquid and solid wastes or residues (or any other potentially PCB-contaminated equipment or materials) resulting from the operation of the PCB destruction system should be retained on-site until the concentration of PCBs and other contaminants (that may be stipulated) have been determined, and until disposal is authorized by the lead regulatory agency.

Disposal of process residues and other waste materials should comply with the minimum requirements (see Section 10) and all additional requirements of provincial and local regulatory agencies.

6.8.2 Decontamination Activities. The on-site decontamination of equipment and/or waste containers should require the specific regulatory approval. It is recommended that tank trucks for transporting PCB bulk fluids (if applicable) be dedicated vehicles. Decontamination and subsequent other use of such vehicles should be regulated by certificates of approval issued by the permitting agency. Subject to lead agency approval, it is recommended that decontamination of the mobile destruction unit be undertaken at each site prior to departure. Facility decontamination activities should be described in the proponent's application for a technology permit.

Re-use and/or disposal of waste drums or containers for PCB wastes should be in accordance with the requirements (see Section 10).

6.8.3 Storm Runoff. Precipitation should be prevented from contacting equipment and materials which could result in PCB contamination. Where such contact inadvertently occurs, the water should be retained and treated as aqueous waste in accordance with Section 10.4.1.

General surface runoff from the bulk liquid treatment site should be periodically monitored. The need for, and frequency of, such monitoring should be determined from site-specific conditions and stipulated as a condition of approval for operation of the facility.

6.9 Operator Training

All operators at the facility should receive comprehensive training on the safe performance of their duties as well as on the safe handling of PCB materials. The training program should be described in detail in the approvals application. The program should provide appropriate training in the following specific areas:

- features and function of the PCB treatment facility;
- knowledge of physical/chemical properties, and environmental hazards of PCB wastes and other dangerous materials used at the facility;
- occupational health and workplace safety regulations, environmental regulations and handling guidelines for PCB wastes and any other dangerous materials used at the facility;
- knowledge of the function and effective use of safety and emergency response equipment; and
- implementation of the emergency contingency plan for the facility (filed with the application for approvals), including emergency response measures for spills and fires and reporting procedures for emergencies (Section 10).

6.10 Data Reporting and Record Keeping

Detailed procedures for all aspects of record keeping and data reporting should be addressed in the Data Quality Assurance Plan which is submitted as part of the approvals application.

Operator records for each PCB treatment site should contain the following types of information: descriptions of PCB wastes processed; owner/operator names; pertinent activity dates/times; monitoring and analytical data; descriptions of spills or other accidental occurrences; inspection records; processing waste data and disposal methods; and other relevant information. It is recommended that records of treatment activities be retained for five years.

It is also recommended that a written report of activities at each site be provided by the operator or owner to the designated regulatory agency. This will assist in

the overall PCB waste management strategy by providing a mechanism for the regulator to review all treatment activities and maintain accurate PCB waste inventories.

6.11 Duration of Operations

If the requirements of this report are observed, there are no technical concerns which justify limiting the term or frequency of operations at a given site. Federal, provincial, or local agencies, however, may wish to stipulate a maximum duration of operation for demonstration tests and/or subsequent approved operation. In such cases, the length of the term should be determined by site-specific considerations including: site characteristics, waste quantity, cost constraints, and allowances for facility setup, shakedown, and decommissioning.

6.12 Site Security

For bulk processing facilities, the site should be securely fenced with access controlled by a locked gate. This may not be practical for facilities that process transformer oil in-situ. Appropriate measures should be taken to prevent unauthorized entry and vandalism when an attendant is not present (24-hour presence of an attendant is recommended). When the facility is in operation, all activities should be adequately and continuously supervised.

7 MONITORING AND INSPECTION

All permit applications for operating PCB treatment facilities should require a plan that addresses the monitoring of operational, emission, and environmental parameters. The purpose of monitoring is to verify the destruction performance of the facility and to document operational compliance with all pertinent regulations. More extensive monitoring will be required during demonstration tests (if tests were necessary) than during commercial operation. In general, the minimum recommended monitoring requirements are:

- **monitoring of process conditions** during routine operation;
- **waste feed and product sampling and analysis** during both demonstration tests (if required) and operation;
- **effluent sampling and analysis** before disposal of operational wastes; and
- **environmental sampling and analysis** before and after tests or routine operations (except for in-situ treatment).

The primary monitoring considerations, which should be reviewed and approved by the regulatory agency, are: the monitoring locations; parameters; sampling and analytical procedures to be used; and the monitoring frequency. The type of monitoring will depend on the type of treatment facility and/or specific operational components that could affect the environment.

7.1 Process Monitoring

Although treatment performance is mainly defined by chemical characterization of process inputs and outputs, specific operating conditions of the process should be monitored (continuously, in some cases) to ensure proper process control and operational safety. The parameters or conditions that should be monitored in a batch or continuous decontamination process are shown in Table 4.

Although monitoring locations and actual parameters depend on the process type, configuration, and mode of operation, the primary conditions recommended to be monitored include: the input feed rates/total volumes; process temperature; reaction vessel pressure; reaction time; amount of reagent(s); and output rates/total volumes (i.e., including both potentially usable products and process waste products/effluents).

Many chemical dechlorination processes are in use, and their treatment efficiency depends on parameters defined by the technology developers. These parameters should be identified in the application for approval.

TABLE 4 RECOMMENDED MONITORING REQUIREMENTS OF OPERATING PARAMETERS CHEMICAL PCB DECHLORINATION PROCESSES

Monitoring Parameter	Unit
Total Waste Feed	
Volume	L
Feed Rate (if applicable)	L/h
Total Volume of Process Chemicals	
Reactive Reagents	L or kg
Solvents (if applicable)	L
Gas Purge	L/h
Filtration Material	kg or L
Reaction Vessel Pressure (continuous)	kPa
Reaction Vessel Temperature (continuous)	°C
Volume of Wastes Generated	
Liquid (aqueous or other)	L
Sludges	L or kg
Solid (filter material or other)	kg or L
Calculated Parameter	
Residence Time	min. or min./batch
Treatment Efficiency	mg PCBs/L in final product

Monitoring data will then be used to determine variations of such process conditions that should remain within the range of approved operating conditions for the facility. For example, for some processes, the key parameters may be reactor temperature and pressure, and would be linked to an automated waste feed cut-off or process shutdown system that will be triggered in the event of range exceedances.

7.2 Performance and Effluent Monitoring

In order to substantiate treatment performance, PCB analysis of process feed, product and all process effluents should be required.

Recommended sampling and analytical requirements that address both routine operation and demonstration tests, based primarily on Ontario regulations[6], are provided in Table 5. Sampling and analytical methodologies, monitoring locations, monitoring frequency, and parameters to be monitored should be approved within each jurisdiction.

Analysis of all input and output streams (e.g., waste feed, product, process waste) should be done during processing at a frequency stipulated by the regulatory

TABLE 5 RECOMMENDED PERFORMANCE AND EFFLUENT MONITORING REQUIREMENTS FOR CHEMICAL DECHLORINATION PROCESS OPERATIONS AND DEMONSTRATION TESTS

Sample Type	Recommended Frequency[a]	Minimum Analysis
1 PCB Feed[b]	- composite samples taken for each PCB waste concentration prior to treatment	- PCBs, chlorobenzenes
2. Product(s)[b]	- at specified intervals until desired final concentration	- same as 1
3. Aqueous Wastes[b] (if applicable)	- at completion of process	- same as 1
4. Sludges/Other Solids[b] (if applicable)	- same as 1	- same as 1
5. Vented Emissions to Atmosphere (if applicable)[c]	- three sample sets for each PCB waste type/concentration	- THC, PCBs, chlorobenzenes, benzene

Notes: (a) The number of samples and sampling intervals depend on the expected treatment duration, specific jurisdictional requirements, and the types of parameters being monitored. Analysis of other compounds may be required depending on the nature of the feed and jurisdictional requirements.

(b) Sampling and analysis of these process streams for these groups of compounds is a minimum recommended requirement during normal operations.

(c) Analysis of vent emissions, in addition to other process streams, is recommended should process demonstration tests be required.

agency. As a minimun, the PCB feed and the decontaminated product should be analyzed for PCBs and chlorobenzenes at each site for each waste type. In most cases, it is anticipated that the feed will consist of homogeneous liquid and only one analysis will be required. Alternately, the product should be analyzed routinely during the process (as required by process conditions) until the desired final PCB concentration of the product has been achieved. Solid/liquid discharges also should be analyzed for these constituents and retained at the site until approved for disposal. Results of incoming and outgoing stream analysis should demonstrate that PCBs are destroyed by the process without the creation of other pollutants that exceed environmental standards, criteria, and guidelines.

For in-situ processing, decontaminated mineral oil that has been returned to transformers for use should be sampled and analyzed for PCB content after a specified time interval (see Section 6.7.2) to ensure that PCB concentrations have remained within acceptable limits (i.e., $\leq$ 50 mg/L total PCBs, which represents a declassified PCB substance).

Air emissions associated with non-thermal destruction processes are normally expected to be low in volume and easily controlled; therefore, monitoring of such emissions in process vents (if applicable) should be considered in demonstration tests only. Requirements for air monitoring should be minimal for such facilities provided that acceptable controls and/or equipment are utilized to avoid contaminant release due to fugitive or vent emissions from any treatment/waste handling operation.

7.3 Environmental Monitoring

The requirements for environmental monitoring should be predetermined by the lead regulatory agency. In some circumstances, environmental monitoring will also be undertaken by the regulatory agency. Although not applicable to in-situ processing, specific environmental monitoring should be done in conjunction with longer term bulk waste decontamination activities in order to detect the occurrence of spills and any potential effect of PCB destruction activities on the local environment. More detailed measurements of contaminant levels in various environmental media should be done if decontamination tests are required or if airborne releases are expected from vents of process equipment.

Recommended environmental monitoring requirements are shown in Table 6. Prior to bulk treatment operations, samples of soil and receiving water (where applicable), should be collected at the site and analyzed for background composition (e.g., PCBs and chlorobenzenes as a minimum). Soil monitoring, should be done after operations at each site, in order to determine the need for site restoration. Water analyses should be considered in cases where the treatment site is directly adjacent to a waterbody or immediately above a groundwater system (e.g., within one metre of the surface).

It is also recommended that additional environmental measurements be done (e.g., ambient air and vegetation monitoring) if process demonstration tests are required.

7.4 Inspection

Facility inspection should be undertaken by the permitting agency in addition to routine inspection by operators of the destruction system. Demonstration test

TABLE 6 RECOMMENDED ENVIRONMENTAL MONITORING REQUIREMENTS APPLICABLE TO CHEMICAL DECHLORINATION SYSTEMS TREATING BULK PCB LIQUID WASTES

Sample Types	Location[a]	Minimum Analysis
1. Soil[b]	- each of four compass point locations surrounding the facility	- PCBs, chlorobenzenes
2. Water[b]	- taken only if location warrants	- same as 1
3. Ambient Air[c]	- same as 1	- same as 1

Notes:
(a) Sampling locations will depend on the characteristics, the type of facility, and information desired. Analysis of other compounds may be required depending on the nature of the feed and jurisdictional requirements.

(b) Sampling and analyses of these environmental media should be required before and after normal commercial operations at each approved site or during demonstration testing.

(c) Ambient air sampling is recommended during process demonstration emissions. Jurisdictional requirements will determine the need for such measurements.

activities (if tests are required) should be thoroughly inspected both before and during testing to confirm that all operational controls, monitoring devices and associated procedures are functioning properly. Similarly, each bulk PCB decontamination site should be inspected before and after operations to determine the condition of the site and any need for restoration. Otherwise, inspection or surveillance during any operations (i.e., in-situ and bulk processing) should be done on both a random and scheduled basis in order to verify that systems comply with all regulations. It is recommended that at least one inspection be done by regulatory personnel per month of operation. Records of the operator should be available for regulatory review at any time. If any emission or waste disposal regulations are found to be violated, or if any other unsafe condition is identified, operations should be terminated until approved to resume.

8 OCCUPATIONAL HEALTH

8.1 Exposure Limit

The protection of workers and the environment are fundamental requirements of PCB treatment operations. Proponents will be required to ensure safe working practices, use precautionary measures that will limit risk of exposure to PCBs and other contaminants, and adhere to occupational health regulations and guidelines.

Most provinces have adopted workplace air concentration limits set by the American Conference of Governmental Industrial Hygienists (ACGIH)[17] that are associated with exposure to specific PCB mixtures (i.e., askarels). These air concentration limits, expressed as Threshold Limit Values (TLVs) and Short-term Exposure Limits (STELs), are:

42% Cl: 1 mg PCBs/m^3 air over 8 hours (TLV)
2 mg PCBs/m^3 air over 15 min. (STEL)

54% Cl: 0.5 mg PCBs/m^3 air over 8 hours (TLV)
1 mg PCBs/m^3 air over 15 min. (STEL)

Threshold limit values are limits defined as the maximum time-weighted average exposure level for an 8-hour working day and 40-hour workweek and STELs are limits defined as the maximum exposure level for no longer than a 15-minute duration and no more than four times per day.

The current occupational health guideline used in Ontario for time-weighted average exposure to polychlorinated biphenyls has been set at 50 $\mu g/m^3$ of air for a 40-hour workweek. This guideline represents an airborne concentration to which it is believed that most workers may be repeatedly exposed, on a daily basis within a 40-hour workweek, over a working lifetime, without adverse effects. An important provision of this guideline states that employees should be protected from skin contact by the use of impervious materials.

8.2 Work Practices and Personal Protective Equipment

All persons handling, operating or maintaining PCB equipment should be adequately trained and familiar with occupational health and safety practices. Polychlorinated biphenyls are readily absorbed by inhalation, ingestion, and skin contact. As the volatility of PCBs increases with increasing temperatures, it is important that all systems and especially processes involving elevated temperatures (i.e., >55°C), are

completely enclosed and/or served by adequate exhaust control and ventilation. In cases where PCBs are being stored in enclosed areas prior to treatment, periodic air sampling should be conducted (e.g., once per month in storage areas) to ensure that workers are not exposed to airborne concentrations higher than those previously identified. When such airborne concentrations are suspected/encountered, workers should be provided with air-supplied respirators, particularly if work is to be conducted in enclosed spaces. Polychlorinated biphenyl working areas should be clearly delineated with restricted access policies in place. Similarly, containers and other equipment (e.g., transfer lines) should be labelled for inspection purposes and to ensure correct handling procedures. It is essential that good housekeeping practices be maintained at all times.

In working with PCBs, strict personal hygiene practices should be observed and skin contact avoided. To protect against dermal exposure, impervious protective clothing, such as gloves, boots, overshoes and overalls should be supplied to workers. Guidance in the selection of personal protective equipment and clothing is available in publications by NIOSH[18] and ACGIH.[19] Eye protection should be used to avoid injury from liquid splashes. Protective work clothing should be regularly inspected to ensure that it remains clean, and in good condition. Thorough personal washing should be done after removing protective equipment and before eating, drinking, or smoking. Eating and other such activities should not be permitted in PCB work areas. Similarly, all tools in contact with PCBs or PCB-contaminated materials should be washed at the end of each day or after use with an appropriate solvent (e.g., varsol, kerosene).

8.3 Medical Surveillance Programs

Where applicable, PCB treatment facility operators potentially exposed to PCBs on a frequent or continuous basis should undergo pre-placement and periodic medical examinations and any clinical tests at intervals specified by the examining physician. Operator exposure records (e.g., results of air sampling), medical histories, and clinical test results should be documented and retained for future reference.

9 TRANSPORTATION OF PCB-CONTAMINATED WASTES AND MOBILE TREATMENT SYSTEMS

9.1 PCB Wastes

Depending on jurisdictional requirements, transport of PCB-contaminated oils in bulk for treatment at a centralized location may be desirable. This section addresses waste transport and, therefore, is not applicable to in-situ transformer oil treatment activities.

All PCB-containing oils must be transported (if applicable) to the treatment site in accordance with the requirements of current federal and provincial legislation. The proponent of the PCB destruction system should clearly indicate, in the approvals application, the specific plans for waste transportation. At a minimum, all involved parties should be identified and the specific arrangements for waste receiving at the treatment site should be addressed. In addition, the contractual arrangements bearing on responsibility for transportation accidents and associated liability should be clearly indicated.

The federal *Transport of Dangerous Goods Act* (TDGA) and complementary provincial legislation specify standards and requirements for the safe handling and transportation of dangerous goods and/or hazardous wastes by all modes of transportation within Canada. Under federal TDGA Regulations, wastes or articles containing PCBs are included in Division 1 and 2 of Class 9 and are to be identified by the Product Identification Number (PIN) 2315. These regulations stipulate the requirements for safety markings and documentation, packaging, safety precautions and training, and emergency training.

The TDGA Regulations and associated provincial regulations also require a completed manifest for each shipment of PCB waste. Copies of the manifest must be completed by each party involved (consignor, carrier, and consignee). In addition, the regulations stipulate reporting requirements for spills of PCBs during transportation and related activities.

Amended regulations specific to the transportation of PCBs are now in force. The amended regulations are summarized in the Dangerous Goods Special Bulletin, TP2711E, ISSN 0710-0914. Information on the summary document is available from the offices listed in Table 7.

TABLE 7 CONTACTS FOR INQUIRIES ABOUT TRANSPORTATION OF PCB WASTES

Jurisdiction	Responsible Agency	Telephone
Federal	Transport Canada Place de Ville (Tower C) Ottawa, Ontario K1A 0N5	(613) 992-4624
Yukon Territory	Department of Community and Transportation Services P.O. Box 2703 Whitehorse, Yukon Y1A 2C6	(403) 667-5832
Northwest Territories	Pollution Control Division Department of Renewable Resources Yellowknife, NWT X1A 2L9	(403) 873-7654
British Columbia	Solicitor General Motor Vehicle Branch 2631 Douglas St. Victoria, B.C. V8T 5A3	(604) 387-5585
Alberta	Dept. of Public Safety Services Dangerous Goods Control 10320-146 Street Edmonton, Alta. T5N 3A2	(403) 422-9600
Saskatchewan	Dept. of Highways and Transportation 1855 Victoria Ave. Regina, Sask. S4P 3V5	(306) 787-5527
Manitoba	Department of Environment Workplace Safety and Health Box 7, 139 Tuxedo Ave. Winnipeg, Man. R3C 3Z1	(204) 945-7094
Ontario	Ministry of Transportation Compliance Branch West Tower, 1201 Wilson Ave. Downsview, Ont. M3M 1J8	(416) 235-3599
Quebec	Ministère des Transports 700, boul. Saint-Cyrille est Québec, P.Q. G1R 5H1	(418) 643-2990
New Brunswick	Dept. of Transportation Kings Place, York Street, Box 6000 Fredericton, N.B. E3B 5H1	(506) 453-2407
Nova Scotia	Department of Transportation 6061 Young Street, Box 156 Halifax, N.S. B3J 2M4	(902) 424-2727
Prince Edward Island	Dept. of Transportation and Public Works Box 2000, 17 Haviland St. Charlottetown, P.E.I. C1A 7N8	(902) 368-5200
Newfoundland	Department of Transportation Box 8710 St. John's, Nfld. A1B 4J5	(709) 576-3454

Provincial legislation complements the TDGA Regulations and may require all parties involved in transportation of PCB wastes to obtain provincial approvals or licenses. These approvals may stipulate additional contractual responsibilities for these parties. The specific agencies to contact for questions about requirements in each of the provinces are listed in Table 7.

9.2 Process Vehicles

Mobile PCB treatment facility transport vehicles must comply with all conventional requirements for transport vehicles. Since these vehicles are not expected to transport PCB waste materials, it is anticipated that the regulations governing waste transport would not directly apply. However, regulations are still under development and individual provinces may wish to stipulate specific precautions or conditions for the movement of mobile PCB treatment systems. It is recommended that the proponent's approval application to operate a mobile PCB treatment system contain a description of the equipment and procedures for transport. This will aid in identifying any appropriate conditions or precautions for equipment cleanup, decontamination or preparation prior to and during transport.

10 PROCESS WASTE DISPOSAL

All liquid and solid wastes and residues (or any other potentially contaminated equipment or materials) resulting from the operation of the PCB treatment system should be retained on-site until analyzed for PCBs and other contaminants (as required) and disposal is authorized by the lead regulatory agency.

Disposal of process residues and other waste materials should comply with the requirements found in the following sections and all additional federal, provincial, and local regulatory agencies.

10.1 Solid Waste Disposal

The requirements of this section refer to the conditions of disposal for solid residues of the PCB treatment facility such as: prefilter material; process salts and sludges; and contaminated cleanup materials. These recommendations are based primarily on contaminant limitations in the "Federal Mobile PCB Treatment and Destruction Regulations"(15).

- it is recommended that solid process residues with a PCB content $\leq$0.50 mg of PCB/kg of waste (0.5 ppm) be defined as non-hazardous solid industrial wastes and disposed of in land disposal sites, or any facilities that are certified to accept such waste, or in accordance with any other applicable regulations of the province; and
- solid residues containing >50 mg PCB/kg of waste are, by definition, PCBs and should be handled as such.

10.2 Container Disposal

Facilities treating contaminated oil in bulk and, in some cases, in-situ transformer oil processing operations, will generally have to dispose of containers contaminated with PCBs. Such containers should be subject to the disposal requirements of Section 10.1. In addition, the following specific requirements should apply:

- the decontamination of any equipment or containers which contact PCB wastes should require the specific formal approval of the lead regulatory agency;
- the re-use of dedicated drums or waste containers should be allowed, subject to careful inspection, to ensure that they are in good condition and meet the general requirements of PCB waste containers;

Alternatively,

- drums for disposal should be triple-rinsed with solvent, if suitable means to dispose of the solvent is available; it is suggested that the volume of each rinse be at least 10% of the container volume; specific procedures for decontamination activities

should be stipulated as a part of the approvals submission and approved as conditions to test or operate the facility;

- it is recommended that drums rinsed in such a manner be disposed of as non-hazardous waste in landfills or other facilities that are certified for such disposal, or, properly rinsed drums can be recovered as scrap metal in a facility that is certified to accept such materials; and
- re-use of rinsed drums (except as containers for non-hazardous waste to be deposited in a certified landfill) should not be allowed.

10.3 Bulk Transport Vehicle Decontamination

The use and subsequent decontamination of tank trucks for transporting **bulk** PCB liquids should be specifically addressed in the approvals application. However, if decontamination of vehicles is required, specific approval for procedures should be a condition of approvals to test or operate the facility.

10.4 Liquid Effluent

10.4.1 Disposal of Wastewaters. Formal approval should be required for discharge of **all** aqueous wastes from the disposal facility upon verification that these discharges contain concentrations of contaminants below regulated levels.

The recommended maximum concentration of PCBs in aqueous wastes is 5µg/L. Acceptable disposal methods[6] for wastewaters which have a PCB content $\leq$ 5 µg of PCB/L of wastewater (as determined by approved analytical methods) include discharge to: a municipal sewage treatment plant; a receiving water body; or soil.

It is recommended that these wastes be retained at the site until analyses are complete and disposal approval has been received. Wastewaters which have a PCB content >5 µg/L should be treated by an approved means to obtain a PCB content of < 5 mg/L before discharge. Dilution of such wastes as a means to achieve allowable discharge levels should not be permitted.

10.4.2 Contaminated Precipitation. At sites where bulk contaminated oil is being treated, the generation of contaminated runoff should be avoided by preventing the infiltration of precipitation to impoundments or containment areas (Sections 6.4 and 6.8).

Where precipitation or runoff becomes contaminated, this liquid should be retained and treated as wastewater according to the requirements of Section 10.4.1.

11 EMERGENCY RESPONSE AND CONTINGENCY PLANNING

11.1 Responsibilities of the Proponent

The proponent of a PCB destruction facility should have (at a minimum) the following obligations and responsibilities regarding emergency response and contingency planning:

- a detailed emergency response and contingency plan should be submitted as a part of the application for regulatory approvals; this plan should be site-specific and should address each component of an emergency plan;
- before PCB decontamination activities take place at a site, the system operator should be prepared to demonstrate that the required emergency response equipment is on-site, readily accessible, and in proper working order; and
- before PCB decontamination activities occur, the system operator should be prepared to demonstrate that on-site personnel are properly trained in the effective use of equipment and are ready and able to implement all parts of the emergency response plans (Section 6.9).

11.2 Potential Emergency Events

As a minimum, the emergency response plan should address the following:

- spills of PCB liquid (e.g., bulked PCB waste fluids stored on-site);
- release of PCB-contaminated fluids, including runoff from storm events, aqueous wastes generated by the treatment process (e.g., mineral oil cleanup water), and aqueous runoff from fire-fighting activities;
- fires involving PCB liquids or wastes (with attention to minimizing dispersal of soot and other residues of fire-fighting activities); and
- catastrophic process failure (e.g., explosion and/or fire involving process equipment).

11.3 Elements of Emergency Action Plans

The specific form and content of an emergency response plan will be dictated by the lead regulatory agency. As a minimum, the plan should include:

- identification of site-specific, high-risk situations;
- advanced notification of local fire officials of site activities;
- advanced consideration and definition of specific actions and equipment for responding to the types of emergency events identified in Section 11.2 under the full range of local weather conditions;
- clear assignment of staff duties, responsibilities, and accountability for implementing all aspects of the plan;
- designation of a contact person to notify appropriate officials of an emergency;

- identification and utilization of local emergency response resources; and
- consideration of the following aspects of the action plan:
    - event discovery,
    - notification of on-site response personnel,
    - first-action response (e.g., immediate containment of spills, immediate actions to protect or evacuate personnel, alerting off-site resources),
    - notification of appropriate regulatory agencies,
    - definition of response action options,
    - action implementation,
    - documentation,
    - assessment of response effectiveness, and
    - reporting.

11.4 Considerations for Specific Emergency Events

The potential severity of the emergency events listed in Section 11.2 varies significantly. Spills of PCB solids are of relatively low hazard and are easily contained and cleaned up. Spills of PCB liquids are of greater immediate concern to the environment and require a higher degree of protection for cleanup personnel. Events involving the partial combustion of PCBs in fires may pose a severe hazard because of the potential generation of highly toxic polychlorinated dibenzofurans (PCDFs) and dibenzodioxins (PCDDs)[20]. Polychlorinated biphenyls, PCDFs, and PCDDs can be widely dispersed in soot and fire-fighting residues. Widespread dispersal of these residues can pose a serious health and/or environmental threat as well as causing severe difficulties and high costs in carrying out a thorough cleanup.

11.4.1 Spills. Compliance with the general design and operating requirements of this report and with the emergency planning considerations outlined in Sections 11.1 to 11.3 should provide sound protection against PCB releases resulting from spills.

11.4.2 Fires. In addition to the general design and operating requirements of this report and the emergency planning considerations outlined in Sections 11.1 to 11.3, particular care should be taken to prevent fires involving PCB materials. Special precautions should include the following:

- isolate PCB wastes (where applicable) from all flammable materials including solvents;
- provide rapid and effective fire extinguishers or other fire control systems in all potential fire areas; chemical foam or carbon dioxide extinguishers are recommended and/or incorporation of inert gas fire control systems (where

appropriate); the use of water to control fires involving PCBs will generate contaminated wastewaters which may be difficult to contain and/or dispose of;

- give special attention to measures which will facilitate the rapid detection of fires;
- provide effective protective gear for fire-fighting personnel; self-contained breathing apparatus should be mandatory and personnel should be informed and trained about health and environmental concerns regarding exposure to PCDFs and PCDDs;
- consider design and response measures which will minimize the dispersal of fire residues via all routes; and
- consult the lead regulatory agency (in consultation with Environment Canada) for guidance on site cleanup.

11.4.3 Failure of Process Condition Monitoring Equipment and Shutdown Controls. Operating controls include the continuous monitoring of process conditions (e.g., temperature, pressure, nitrogen purge) with interruption of the waste feed and/or automatic shutdown of the process if allowable operating ranges of the parameters are exceeded. Since failure of the shutdown system under upset conditions could result in the risk of fire, the contingency plan should address the detection of such failures as well as the description of manual procedures for interrupting waste feed and/or shutting down the waste treatment system.

11.4.4 Catastrophic Failure. Although a major fire or explosion involving the process or key controls is highly unlikely, the emergency response plan should consider these potential situations. As a minimum, off-site resources for dealing with a major emergency should be identified and integrated with the emergency response plan. The area of impact for catastrophic failure should be defined with appropriate actions stipulated in the response plan (e.g., evacuation of affected off-site areas).

12 SITE CLEANUP AND CLOSURE

Upon termination of operations at each site, prior to or concurrent with movement to a new location, the proponent will be required to restore the site to a condition satisfactory to the regulator. Site decommissioning should be done according to the closure plan of the application and any stipulations of approvals. This will normally involve removal of equipment, temporary structures, containers, berms, and process wastes, and possibly may involve site cleanup and disposal of additional cleanup materials. Recommended guidelines pertaining to decontamination activities and waste disposal have been addressed in Section 10.

Although the sequence of decommissioning activities may vary, the general activities and recommended requirements after process termination are:

- decontamination of containers (where applicable) or other equipment as per approval;
- submission of process waste samples for analysis by an independent laboratory approved by the regulatory agency and procurement of results and regulator approval prior to waste disposal;
- disposal of all operational wastes in an approved manner;
- arrangements for removal of decontaminated mineral oil (if applicable);
- the conduct of post-operational environmental monitoring at sites where large quantities of bulk oils have been treated, particularly in the vicinity of waste handling or processing areas;
- provision of operational reports to the regulator;
- inspection of the site; and
- transportation of the mobile treatment process to a new location in accordance with new site application/approval requirements.

In the event that the concentrations of PCBs or other compounds in soils, or other post-operational environmental samples, are found to exceed levels measured before operations, the proponent will be required to take remedial site restoration measures. That is, the site area should be cleaned and restored to a condition acceptable to the regulatory agency as defined by jurisdictional guidelines.

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1. Environment Canada, "The Evaluation of Mobile and Fixed Facilities for the Destruction of PCBs", prepared by the Ontario Research Foundation, Environment Canada Report, EPS 3/HA/5 (1989).

2. Environment Canada, Manual for the Management of Polychlorinated Biphenyl (PCB) Wastes, Environment Canada Report (1987).

3. Chandler, A.J., M.J. Eamon and R.B. Caton, Interim National Emission Criteria for PCB Destruction Facilities, report prepared by Concord Scientific Corp. for the Canadian Council of Resource and Environmental Ministers (CCREM) (March, 1986).

4. Ontario Ministry of the Environment, Preliminary Hearing Document on Proposals for the Regulation of Mobile PCB Destruction Facilities in Ontario, September 1984, including revisions (January 21, 1985).

5. The Commission on the Regulatory Control of Mobile PCB Destruction Facilities, Report of the Commission (Ontario) (June 28, 1985).

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11. *Environmental Contaminants Act*, Chlorobiphenyl Regulations No. 1 (Product), The Canada Gazette, Part II, 114(13): 2272 (July 9, 1980).

12. *Environmental Contaminants Act*, Chlorobiphenyl Regulations No. 2 (Product), The Canada Gazette, Part II, 119(10): 2145 (May 15, 1985).

13. *Environmental Contaminants Act*, Chlorobiphenyl Regulations No. 3 (Release), The Canada Gazette, Part II, 119(10): 2147 (May 15, 1985).

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17. American Conference of Government Industrial Hygienists (ACGIH), TLVs: Threshold Limit Values for Chemical Substances and Physical Agents in the Workroom Environment with Intended Changes for 1984 (1984).

18. U.S. National Institute for Occupational Safety and Health (NIOSH), Personal Protective Equipment for Hazardous Materials Incidents: A Selection Guide, NIOSH Publication No. 84-114 (October, 1984).

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APPENDIX I

SUMMARY AND STATUS OF AVAILABLE TECHNOLOGIES

APPENDIX I SUMMARY AND STATUS OF AVAILABLE TECHNOLOGIES

The recommendations in this report apply to any mobile chemical treatment system for the decontamination of PCB-contaminated liquids. These systems include sodium-based technologies which have been applied commercially to destroy PCBs in liquid PCB wastes as well as non-sodium based dechlorination technologies which are under development.

A detailed description and assessment of these PCB dechlorination technologies is presented in a recent Environment Canada report entitled: Evaluation of Mobile and Fixed Facilities for the Destruction of PCBs,(1) and only a brief discussion is presented here. The full-scale, sodium-based process for the decontamination of PCB-contaminated oil is a proven PCB destruction technology. Treatment of oils with PCB concentrations exceeding 10 000 ppm is usually technically possible but not economical. The nature of process emissions that require control is depicted in Figure 3.

The most common chemical destruction method is based on an alkali metal reagent (sodium) which reacts selectively with the chlorine in the PCB molecule to produce sodium chloride and non-halogenated polyphenyl waste. In most commercial systems, the products of this reaction are readily separated to permit the base oil to be recycled or re-used. Other chemical dechlorination methodologies are also under development. In practically all cases, moisture and/or excess water requires removal from the waste to be treated before processing.

Operations of dechlorination systems usually involve three steps:

- pretreatment of the PCB waste feed (with removal of impurities by filtration);
- waste decontamination by chemical reaction at room or somewhat higher temperatures; and
- clarification of the mineral oil product to separate the process wastes; nitrogen gas is normally introduced to the reaction vessel to eliminate air because of oxygen sensitive reagents and to prevent fire that could result from hydrogen evolution.

Contaminated oil feed rates for chemical dechlorination systems vary with technology type and concentration of PCBs in the contaminated oil. Typical feed rates range from 700 to 3000 L/h. These mobile systems are comprised of one or two trailer modules and require one to three days of set-up time. Wastes generated are reaction by-product sludges, cartridge filters and rags, and/or other cleanup materials. Normally, emissions to air are minimal and regarded as an unimportant relative to emissions from thermal destruction technologies.

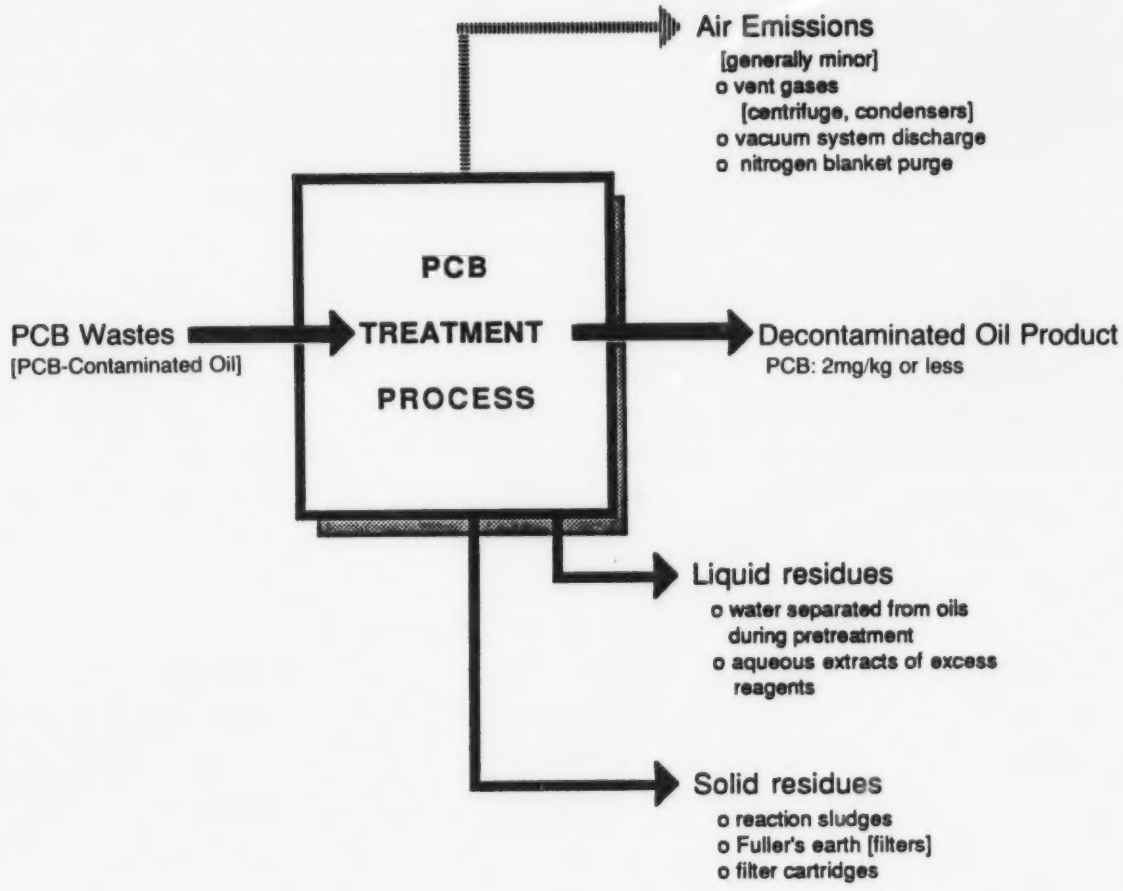

FIGURE 3 OVERVIEW OF CHEMICAL TREATMENT OF PCB LIQUIDS

APPENDIX II

OVERVIEW OF APPROVAL REQUIREMENTS AND PROTOCOL USED IN ONTARIO

APPENDIX II OVERVIEW OF APPROVAL REQUIREMENTS AND PROTOCOL USED IN ONTARIO

Figure 4 represents an overview of application protocols, authorization stages and general components and time constraints involved in conducting demonstration tests and operating a mobile PCB destruction facility in Ontario.

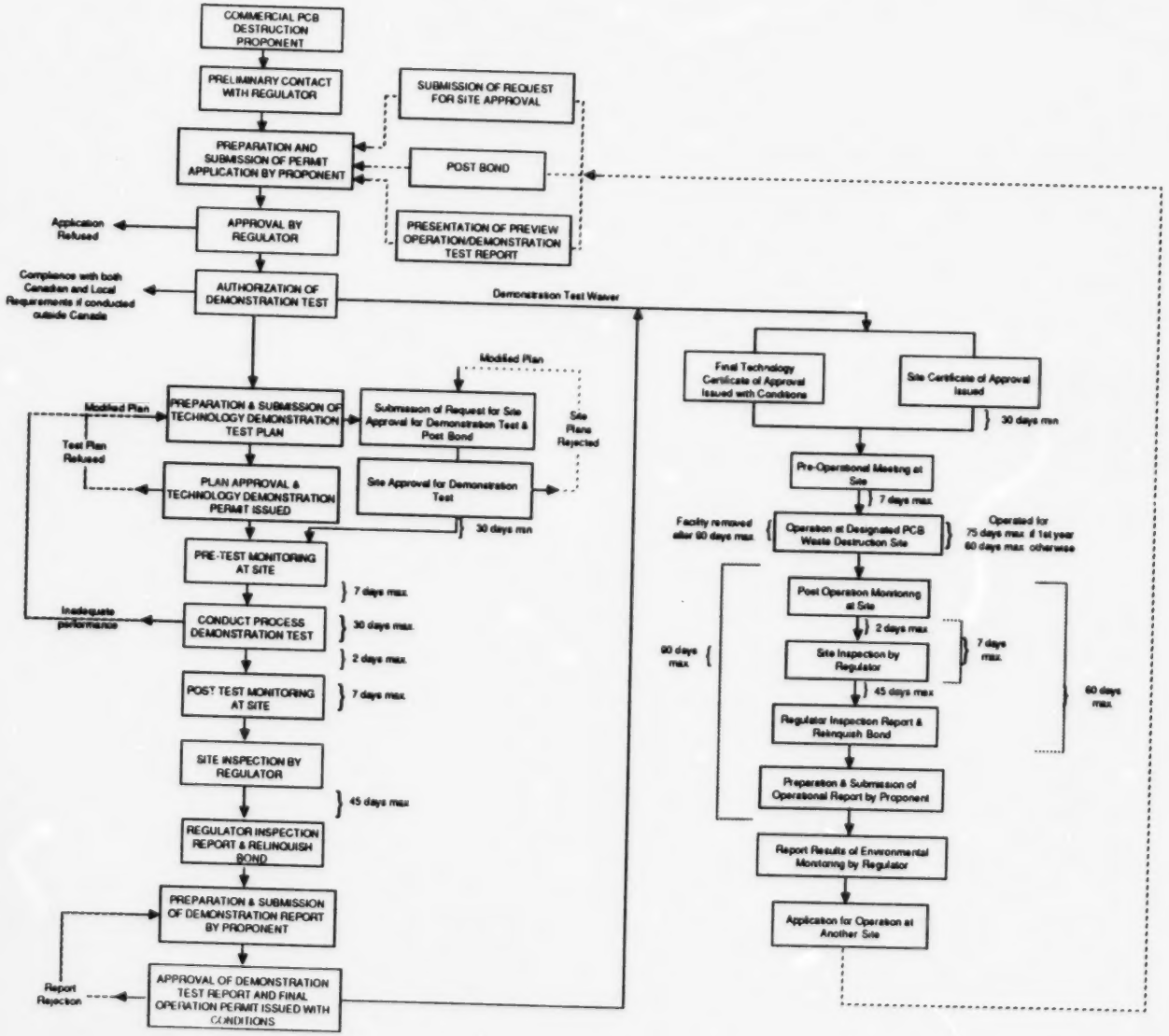
COMMERCIAL PCB DESTRUCTION PROPONENT
PRELIMINARY CONTACT WITH REGULATOR
SUBMISSION OF REQUEST FOR SITE APPROVAL
PREPARATION AND SUBMISSION OF PERMIT APPLICATION BY PROPONENT
POST BOND
Application Refused
APPROVAL BY REGULATOR
PRESENTATION OF PREVIEW OPERATION/DEMONSTRATION TEST REPORT
Compliance with both Canadian and Local Requirements if conducted outside Canada
AUTHORIZATION OF DEMONSTRATION TEST
Demonstration Test Waiver
Modified Plan
Modified Plan
PREPARATION & SUBMISSION OF TECHNOLOGY DEMONSTRATION TEST PLAN
Submission of Request for Site Approval for Demonstration Test & Post Bond
Site Plans Rejected
Test Plan Refused
PLAN APPROVAL & TECHNOLOGY DEMONSTRATION PERMIT ISSUED
Site Approval for Demonstration Test
30 days min
PRE-TEST MONITORING AT SITE
7 days max
Inadequate performance
CONDUCT PROCESS DEMONSTRATION TEST
30 days max
2 days max
POST TEST MONITORING AT SITE
7 days max
SITE INSPECTION BY REGULATOR
45 days max
REGULATOR INSPECTION REPORT & RELINQUISH BOND
PREPARATION & SUBMISSION OF DEMONSTRATION REPORT BY PROPONENT
Report Rejection
APPROVAL OF DEMONSTRATION TEST REPORT AND FINAL OPERATION PERMIT ISSUED WITH CONDITIONS
Final Technology Certificate of Approval Issued with Conditions
Site Certificate of Approval Issued
30 days min
Pre-Operational Meeting at Site
7 days max
Facility removed after 90 days max
Operation at Designated PCB Waste Destruction Site
Operated for 75 days max if 1st year 60 days max otherwise
Post Operation Monitoring at Site
2 days max
90 days max
Site Inspection by Regulator
7 days max
45 days max
60 days max
Regulator Inspection Report & Relinquish Bond
Preparation & Submission of Operational Report by Proponent
Report Results of Environmental Monitoring by Regulator
Application for Operation at Another Site

FIGURE 4 GENERAL APPROVAL REQUIREMENTS AND PROTOCOL USED IN ONTARIO

APPENDIX III

RECOMMENDED CONTENT OF A TECHNOLOGY PERMIT APPLICATION FOR MOBILE PCB TREATMENT SYSTEMS

APPENDIX III RECOMMENDED CONTENT OF A TECHNOLOGY PERMIT APPLICATION FOR MOBILE PCB TREATMENT SYSTEMS
(modified from Reference 8)

1. PERMIT COVER
   - Technology Identification (standardized terminology)
   - Company Identification (name, address, contact)

2. SUMMARY
   - Process
   - Approval Status
   - Location of Facility (current)

3. PROJECT ORGANIZATION
   - Chart
   - Text
   - Contractual Arrangements

4. WASTE DESCRIPTION
   - Type/Concentration Range
   - Total Amount/Feed Rate
   - Physical/Chemical Description

5. PROCESS ENGINEERING DESCRIPTION
   - General Overview
     - description of key components and configuration
     - flow diagram
     - mobility features and transportation requirements
     - size of facility and components
   - Waste Feed and Handling System
     - storage, handling and distribution system (waste and other process inputs)
     - feed pre-treatment requirements
     - design and actual maximum/minimum feed rates
   - Waste Feed Shutdown System
   - Treatment System
     - principle and mode of operation
     - safety features
     - contact time
     - feed/operational restrictions (e.g., reaction vessel filling constraints)
   - Emission/Effluent Controls
     - expected air, water or solid waste emissions (types, concentrations)
     - fugitive air emission control (adsorbent, vent heights if applicable)
   - Process Operating Conditions
     - run duration (minimum, maximum if applicable)
     - temperature/pressure control
     - volume or flow of process inputs
     - other process control features (e.g., inert gas purge)
   - Process Chemicals Used
     - handling systems
     - types and quantities of reagents
     - chemical composition (if non-proprietary)
     - reagent stoichiometric requirements
     - other chemicals used
     - safety features
   - Facility Service and Support
     - power, water, other service requirements
     - laboratory and other support requirements
   - Product Handling
     - storage capacity and handling systems
     - upgrading/clarification procedures
     - disposal procedures (if applicable)
   - Liquid/Solid Residue Handling Systems and Disposal
     - storage capability and handling systems
     - residue quantities
     - disposal requirements and procedures

6. OPERATIONAL PLAN
   - Startup, Shutdown Procedures
   - Proposed Activity Schedule
   - Decontamination Activities

7. SAMPLING AND MONITORING PLAN
   - Scope and Extent of Monitoring (process, emission, environmental)
   - Sampling/Monitoring Parameter List
   - Input/Output Monitoring
   - Sampling/Monitoring Procedures
   - Sampling Design (frequency, number of samples, locations)

8. SAMPLE ANALYSIS PROCEDURES
   - Appropriate Methods
   - Written Protocols
   - Apparatus/Equipment
   - Calibration and Maintenance
   - Data Reduction and Storage

9. INSPECTION PROCEDURES
   - Waste Feed System
   - Reagent Feed System
   - Waste Feed Cut-off System
   - Pollution Control System
   - Alarms
   - Fire Extinguisher Systems

10. SPILL AND ACCIDENT PREVENTION CONTROL AND COUNTERMEASURES PLAN
    - Appropriate Preventative Measures and Contingencies (spills, fire, explosions)
    - Containment and Cleanup Procedures/Equipment
    - Operational Upset Feedback/Shutdown Systems
    - Vandalism Prevention

11. OCCUPATIONAL HEALTH AND SAFETY PLAN
    - Operation Protection (clothing, respirators, wash facilities)
    - Medical Surveillance Programs

12. TRAINING PLAN
    - Knowledge of Facility and Emergency Response Procedures
    - Knowledge of Waste Handling and Occupational Health Guidelines

13. INSURANCE COVERAGE
    - Liability Coverage
    - Other Monetary Assurance

14. QUALITY ASSURANCE PLAN
    - Format
    - Organization and Responsibility
    - QA Objectives (precision, accuracy, completeness, representativeness)
    - Monitoring, Sampling, Analysis Procedures
    - Calibration Procedures and Frequency
    - Data Reduction, Validation and Reporting
    - Internal/External Quality Control Checks
    - Prevention Maintenance and Operational Safety
    - Specific Procedures to Assess Data
    - Corrective Action
    - QA Report

15. CLOSURE PLAN
    - Product/Waste Removal
    - Site Cleanup (as required)
    - Activity Report

APPENDIX IV

RECOMMENDED CONTENT OF A DEMONSTRATION TEST PLAN FOR PCB TREATMENT SYSTEMS

APPENDIX IV RECOMMENDED CONTENT OF A DEMONSTRATION TEST PLAN FOR PCB TREATMENT SYSTEMS

Need for Demonstration Testing and Test Plan Submission

Test Need: In reviewing permit applications, regulators must decide whether or not a process demonstration is required. This decision is based upon the degree to which the technology has been developed or used, former compliance in another jurisdiction, and the extent of environmental risk pertaining to the type of technology. In order for regulators to support an application approval without further testing, the applicant must satisfy the regulator that all operational and environmental standards, criteria, or guidelines within the jurisdiction can be consistently met.

Test Plan: Should a process demonstration be required, the proponent should submit a test plan to the regulator in order to receive a permit that allows operation on a limited amount of PCB-containing waste. A objective of the demonstration test is to establish process conditions in conjunction with sufficient characterization of process emissions/effluents by comprehensive monitoring in order to demonstrate, in a safe manner, that the required treatment efficiency can be achieved by the facility for a given PCB waste feed rate and composition.

A summary of the basic recommended technical content of the demonstration test plan and other discussion pertinent to tests are found in the following table.

ACTIVITY PLAN	CONTENT DESCRIPTION
1. OPERATING REQUIREMENTS DURING DEMONSTRATION	
Operational Plan and Test Parameters	- supply information on mobility features which may require demonstration and the mode of facility operation specific to planned test (e.g., batch/continuous) - define process operating parameters/conditions to be maintained during testing with stated limitations to be demonstrated (e.g., temperature, pressure, chemical requirements) - define operational controls to be tested - describe any shakedown requirements (e.g., pretest with non-PCB containing feed) - define test strategy (e.g., number of tests per type/concentration of PCB waste) - specify, if applicable, whether or not operations are conducted with energized transformers and associated voltage limitation
Waste Feed Plan	- define procedures for unloading/storing/transferring PCB feed to the process - identify required bulk storage and waste volumes expected to be handled during tests including PCB feed, other chemicals, and means of transport to site (if applicable) - define planned minimum/maximum feed rates and PCB concentrations by type of waste - waste preparation requirements (e.g., filtration, solvent/reagent blending, preheating)
Spill Control and Emergency Response Plan	- describe plans to test waste feed or process cut-off systems when process conditions deviate beyond stated limits - define tests for alarms, fire extinguisher systems and other contingency plans during process demonstration - identify facilities for spill prevention/containment, retention of solid/liquid process waste streams or products until discharge is permitted (i.e., sufficient capacity for entire demonstration test), means to prevent accumulation of PCBs or other pollutants in precipitation runoff) - operator training demonstration in normal and emergency situations (i.e., knowledge of facility, environmental and safety concerns, emergency response procedures)
2. SAMPLING AND MONITORING PLAN	
General Requirements and Monitoring Locations	- the designed plan should include both process and environmental monitoring to ensure that sufficient samples and data are available to characterize the environmental significance of operations (some samples may be required for subsequent evaluations) - identify process operating conditions that require continuous monitoring during tests - describe all process/emission monitoring and environmental sampling locations - specify the number of samples per location and test
Monitoring Parameters a) Process and Emissions	- design should indicate monitoring parameters and summary of data to be obtained - examples of parameters to be measured are: PCBs and other pollutants in both PCB waste feed and reagents introduced, operating parameters such as temperature and pressure, PCBs and other pollutants in the final product or liquid/solid/sludge effluents, residual reagent in the final product or effluents, PCBs and other contaminants in emissions to air (including vents)
b) Environmental	- the plan should incorporate environmental sampling associated with pre- and post-testing and during demonstration tests - e.g., PCBs and other pollutants in soil, water, vegetation and ambient air (where required) - in some instances, this or a portion of the environmental monitoring may be undertaken by the regulatory agency
Sampling and Monitoring Methods	- specify proposed sampling and monitoring methods for each measurement which, in most cases, will require approval by the regulator - indicate the frequency, replication and sample size (e.g., feed composition may require continuous collection) - define any sample transport or preservation requirements
a) Analysis Method	- specify proposed analytical methods for each type of sample indicating the procedures/instrumentation to be used for analysis with information on calibration standards/procedure, anticipated detection limit
b) Recording/Record keeping	- identify data reduction procedures - provide calculation methodology that will be used to demonstrate treatment efficiency or material balances using appropriate engineering units - identify record keeping and sample custody plans
3. DISCHARGE CONTAINMENT PLAN	- define measures to contain liquid effluent, solid wastes, material products, contaminated materials resulting from demonstration tests until disposal approval is received
4. QUALITY ASSURANCE PLAN	- define quality assurance procedures with respect to test-specific information such as: system performance, inspection, preventative maintenance, operational safety - define quality assurance procedures with respect to measurements and data validation e.g., sampling/analytical methods, calibration, precision, accuracy, sample representativeness
5. SITE-SPECIFIC PLAN	- define test location and conformity to any required site selection criteria (if applicable) - specify proposed operating schedule (e.g., planned daily activities), dates, and test duration in conformance with any jurisdictional time-constraint requirements

Note: Data provided should be specific to the planned demonstration test and reference made to additional information supplied in the technology permit application unless different (e.g., project organization, technology description).

APPENDIX V

TOXICITY FACTORS

APPENDIX V TOXICITY FACTORS

CONGENER		TOXICITY FACTOR
PCDD		
1.	2,3,7,8 - T4CDD	1.0
2.	1,2,3,7,8 - P5CDD	0.5
3.	1,2,3,4,7,8 - H6CDD	0.1
4.	1,2,3,6,7,8 - H6CDD	0.1
5.	1,2,3,7,8,9 - H6CDD	0.1
6.	1,2,3,4,6,7,8 - H7CDD	0.01
7.	08CDD	0.001
PCDFs		
8.	2,3,7,8 - T4CDF	0.1
9.	1,2,3,7,8 - P5CDF	0.01
10.	2,3,4,7,8 - P5CDF	0.5
11.	1,2,3,4,7,8 - H6CDF	0.1
12.	1,2,3,6,7,8 - H6CDF	0.1
13.	1,2,3,7,8,9 - H6CDF	0.1
14.	2,3,4,6,7,8 - H6CDF	0.1
15.	1,2,3,4,6,7,8 - H7CDF	0.01
16.	2,3,4,6,7,8,9 - H7CDF	0.01
17.	08CDF	0.001